PROJECT facts

U.S. DEPARTMENT OF ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

ENVIRONMENTAL WATER AND RESOURCES

06/2000

INJECTION OF FGD GROUT TO ABATE ACID MINE DRAINAGE IN UNDERGROUND COAL MINES

PRIMARY PROJECT PARTNER

American Electric Power Co.
Columbus, OH

MAIN SITE

Roberts-Dawson Mine Site
Muskingum/Coshocton County, OH

TOTAL ESTIMATED COST

$2,404,500

COST SHARING

DOE	$ 200,000
Non-DOE	$2,204,500

Description

Acid Mine Drainage (AMD) from abandoned underground coal mines in Ohio is a concern for both residents and regulatory agencies. Effluent from these mines is typically characterized by low pH and high iron and sulfate concentrations and may contaminate local drinking-water supplies and streams. Concurrently, the disposal of flue gas desulfurization (FGD) sludge in landfills represents a significant cost to the electric utility industry. After fixation with fly ash and lime for handling purposes prior to disposal, the FGD sludge is cementitious and alkaline in character, which encourages the potential utilization of the fixated FGD material for mine grouting and AMD neutralization purposes. The objective of this project was to demonstrate the technical feasibility of injecting fixated FGD sludge into a small, abandoned underground coal mine in Coshocton County, Ohio (Roberts-Dawson mine) for the purpose of mitigating AMD from this mine. The FGD material was provided from American Electric Power's (AEP) Conesville Plant, which is located about 5 miles north of the mine.

Two general types of FGD grouts were injected into the mine. The first type was a "mine seal" grout mix consisting of a fly ash:FGD sludge ratio of 1.25:1, with 5% added lime and enough water to create a grout with a 4 to 6-inch slump. Design strength of the mine seal grout was a minimum of 145 psi after 91 days of curing. By filling the lower, down-dip areas of the mine completely with this grout, it was expected that the remainder of the mine workings would become inundated with water, which would in turn reduce the rate of pyrite oxidation that is the source of AMD. Clay seals were constructed at all four mine openings in order to retain the injected grout within the mine while allowing water to escape via pipes placed at the bottom of the seals. The second grout type, a more fluid, "infill" grout mix, was injected into the up-dip portion of the mine workings in order to neutralize the acid water that would be stored in the mine after sealing, and to cover pyritic surfaces that could generate additional acidity. The infill grout had a fly ash:FGD ratio of 1:1, with 5% added lime and enough water to create an 8 to 10-inch slump. Strength of the infill grout was not a primary concern, but values of about 75 psi at 91 days curing were expected.

A total of 318 vertical grout holes were used to inject over 23,000 cubic yards of grout (combined mine seal and infill grout) into the Roberts-Dawson Mine. Despite the extensive mine seal grouting, water continued to flow from the drain pipes at two of the clay seals. In an effort to complete the sealing, the drain pipes were grouted shut, and pressure grouting was performed in a set of 20 closely-spaced holes behind one of the clay seals. This temporarily halted the flow of water from the mine, but flow re-emerged a few weeks later from above the top of the clay seal at the mine opening with the lowest topographic elevation. This mine opening is connected to an unmapped set of mine workings

Injection of FGD Grout to Abate Acid Mine Drainage in Underground Coal Mines

whose overall size and degree of inter-connection to the Roberts-Dawson mine was uncertain prior to the start of grouting. It is believed that flow from this mine opening consists of flow from the unmapped (and ungrouted) workings along with water that has been diverted into these work-ings from the grouted Roberts-Dawson mine.

Description

Twelve surface water quality monitoring points around the periphery of the Roberts-Dawson mine have been sampled monthly to determine the flow rates and quality of the mine drainage and to assess the impact of this drainage on existing surface streams. Although total flow from the mine appears to be significantly lower than before grouting, further study is needed to determine whether the changes have resulted from seasonal effects or grouting. Nests of ground water monitoring wells were installed upgradient and downgradient of the Roberts-Dawson mine. Work is now being focused on determining the long-term surface and ground water quality changes at the mine site, evaluating the long-term integrity of the injected grout, and developing a comprehensive ground water flow and solute transport model to describe the hydrogeologic changes resulting from the grouting.

Goal

To ensure the most cost-efficient delivery of electrical power, the U.S. Department of Energy (DOE) is conducting research and development to improve coal combustion by-product (CCB) management. The research program emphasizes characterization and reuse of CCBs to help stimulate markets for new materials such as those produced under the DOE's Clean Coal Technology program. Over the next 5 to 10 years, the program's goals are to develop processes leading to a 100% increase in the current rate of FGD by-product use, a 10% increase in the national rate of overall CCB use, and a 25% increase in the number of CCB applications considered "allowable" under state regulations.

Benefits

- Total flow from the Roberts-Dawson mine workings appears to be significantly reduced compared to pre-grouting flow rates.
- Static water levels within the mine rose about 6 feet after grouting, which was sufficient to inundate the mine floor in the down-dip areas.
- Practical construction methods for conducting mine sealing operations using large volumes of FGD grout as the primary sealing material were demonstrated.

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